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ABSTRACT

The Electronic Studio, developed by the Rice University (Texas) Center for Technology in Teaching and Learning (CTTL), serves a number of purposes related to the construction and development of learning projects. It is a workplace, a display area, and a repository for tools, data, multimedia, design projects, and personal papers. This paper presents an overview of how the Electronic Studio concept can serve as an environment in which project-based learning can flourish by facilitating construction, collaboration, and sharing of projects and information objects. Discussion includes the design process; sample projects of the first iterations; refining the Electronic Studio; and differences between the Internet and intranets. Examples are provided of projects already under implementation that take advantage of intranet technologies such as server-based databases and scripts to enable users to participate in a collaborative knowledge base construction to create cross-cultural materials. Creating the technology environment is discussed, including preparing learners, network infrastructure, classrooms, uniformity of system configurations, World Wide Web-based databases, multimedia resource galleries, and use of a Web boarding system for communication. (AEF)

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THE ELECTRONIC STUDIO AND THE INTRANET: NETWORK-BASED LEARNING

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The deployment of a learning environment requires the development of two components: (a) a guiding philosophy and (b) a system that supports the philosophy in practice. The Electronic Studio is a distributed learning environment based on constructivist and constructionist ideas as explained of Papert (1993), Negroponte (1994) and Resnick (1994, 1996). In the Electronic Studio the support system is provided by a network based computer system. Papert (1993) has argued that people learn more effectively when they are engaged in the creation of objects that are relevant and meaningful to their lives. In this process, students learn more by creating an object after designing its parts than by taking apart something that is handed down to them (Negroponte, 1994; Resnick, 1994). This, by definition, is a problem oriented instructional environment. The characteristics and advantages of problem based learning have been reviewed by Blumfeld et al. (1991). A technologically enhanced system based on a network can support this project-based approach helping learners to solve problems in a collaborative fashion and facilitate the process beyond the confines of space. This makes it possible to extend the notion of constructionism to distributed constructionism, a situation where people who are not working in close physical proximity can collaborate in creation and construction (Resnick, 1996).

This is an overview of how the Electronic Studio concept, developed by Rice University's Center for Technology in Teaching and Learning (CTTL) can serve as an environment in which project based learning can flourish by facilitating construction, collaboration and sharing of projects and information objects. See (http://cttl.rice.edu). The Electronic Studio has gone through several iterations. The initial phases of the current iteration have been developed and deployed at this point. Other aspects are still under implementation.

Electronic Studio

The Electronic Studio is the result of CTTL's System-After-Next vision for technology where people, processes, and technology are integrated (Gorry, 1997). The Electronic Studio serves a number of purposes, all focused on the construction and development of projects. It is a workplace, a display area and a repository for tools, data, multimedia, design projects, and personal papers. But because of our use of networking, an Electronic Studio is not bound to a single place. Learners, linked together by a telecommunications network, can work simultaneously within a studio to share notes, assignments, documents, images, video, and sound.

An Electronic Studio provides a unified front for access to remote information sites. For example, students can access information from libraries, and gain access to databases around the world, or students can view the resources at a museum and interact with its curators. Electronic Studios allow groups of learners from different environments to collaborate in the development and exploration of curricula. It permits two way interactive video discovery and enable learners to become builders of common knowledge bases by creating shared repositories of information.

The distributed nature of the Electronic Studio depends on the development a networking infrastructure. That infrastructure enables uses of computing that go beyond the single student to foster the sharing of educational resources between teams of learners and individuals. Because of its nature, the Electronic Studio is a great system for student centered learning, as discussed by Norman and Sphorer (1996), where groups can be engaged in active exploration, construction and problem solving.

Design process

The Electronic Studio concept does not focus on a static environment. It is an environment that is constantly transforming due to of changes in technology and in user interests and needs. Therefore, the development of an Electronic Studio project follows an iterative prototyping approach (Gorry, 1997) with significant involvement of the target population. At the project site, consultation with the users takes place so that their needs and concerns are addressed.

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Sample Projects of the first iterations

The Center for Technology in Teaching and Learning has been supporting and developing Electronic Studios at Rice University and at The Rice School/La Escuela Rice, a k-8 educational institution. These developments have been centered on the creation of rich World Wide Web resources that serve students and instructors as centers for information delivery, exchange and communication. One such endeavor is The Galileo Project at Rice University (http://es.rice.edu/ES/humsoc/Galileo/) which was developed as part of a college level course on the life of the famous astronomer.

Galileo's Web (http://riceinfo.rice.edu/armadillo/Rice/Galileo/) was the second iteration of the Galileo Project. In this version, the Galileo materials were adapted to the k-8 learning environment of the Rice School/La Escuela Rice. Using a more integrated environment where learners had access to creative materials through a reduced number of entry points extended the Electronic Studio functionality. A website tied several of the distributed classroom functions together, including reference materials, lesson plans, media collections and display materials. The second entry point was provided by a local area network that provided access to locally stored materials and documents.

The Virtual Villas Project in Galileo's Web represents the kind of projects that learners can develop in an Electronic Studio environment. Here, teams of students designed and built virtual reality villas for Galileo. In the process they learned about the history of science, mathematics and architecture while collecting information and building elements from network repositories and World Wide Web sites (Solís, 1997a)

The Rice University and Rice School/ Escuela Rice Electronic Studio projects relied on two technologies: a) the institutional Local Area Network (LAN) and b) the Internet. The LAN provided teams with distributed, shared spaces for tools and documents, as well as with widely accessible private spaces. The Internet, on the other hand, provided learners with access to information resources and a communication system for remote locations. What these two sites lacked was an integrated access system for information and communication. Users were able to access all the necessary resources through the networking systems, but the process required them to become familiar with procedures and technologies, which were in not necessary for the goals of the projects.

Refining the Electronic Studio – higher integration

In a new iteration, the Electronic Studio is being deployed at Hogg Middle School, an inner city school in Houston, Texas. The Electronic Studio model under development at this site takes advantage of new technologies developed after the deployment of the previous iterations. The technological goal for this model is to create a highly integrated interface and seamless environment to enable learners to concentrate on the creative processes and learning. To achieve this, an Intranet component has been added to the support technologies.

What is an Intranet?

The term Intranet is used here to refer to a local or wide area network based on Internet protocols and designed to serve the internal needs of an organization. It may or not be connected to the Internet and typically includes e-mail, file sharing and other basic network services. One of the advantages of Intranets they can be deployed over existing networks and require very little re-engineering. (Khan and Logan, 1996; Brandt and Nash, 1996).

The main differences are that Intranets offer a single point of entry to network based resources and the focus of the development is on the users of the organization involved, not on the global community. This entry point is a World Wide Web page. The Intranet approach has the potential of impacting learning in an Electronic Studio environment as it can create a seamless working environment for the users. In the same way that students walk into a traditional classroom and can interact with tools and materials to develop projects, the unifying approach of an Intranet allows learners to concentrate on the task at hand letting technological nuisance take a back seat. This aspect was important since the reduction of procedural steps facilitates the adoption of technology in organizations that have not relied on it to function (Solís, 1997b).

Several schools and school districts are already using Intranets, but not under this approach. For example, the Hueneme School District and Blackstock Jr. High in Oxnard, California, use an Intranet system for cross-district communications, file sharing and source code implementation (Sowinska, 1997). The Montgomery County Public School system, in Rockville, Maryland, in its "Plan for Educational Technology Implementation: The Global Access Project and Beyond" has established, as part of its core strategies the installation of building wide networks and Internet and Intranet software.

The Electronic Studio at Hogg Middle School

What follows are some projects are already under implementation. These projects take advantage of Intranet technologies such as server based databases and scripts to enable users to participate in a collaborative knowledge base construction to create cross-curricular materials. One of the most important criteria in this area was the desire to enable students and teachers to collaborate in learning, while removing unnecessary steps and fronts in the process.

The Online Personal Journals and The Rainforest Poets

The online personal journals were designed so that students would have a personal writing space that could be accessed at the touch of a button and be worked on from

any room in the school. Other students could read each other's materials from any room in the building and teachers could reply to student and comment on their materials. All this happened within a browser environment. Students and teachers looked at the same interface regardless of where they were or what computers they were using. At the same time, files were saved at designated spots at the click of another button. In the Rainforest Poets environment, users collaborated in the creation on poetry based on tropical rainforest themes, again, using a web based interface, with more concern on collaboration than with technology.

Weather Trackers

The processes of science rely on data collection and analysis within a research framework. The objective of this project was to enable learners to collaborate in data gathering and to create a distributed database that could be used across disciplines to meet the needs of individual learners. Taking advantage of the wide area network, schools in the district take weather measurements at their sites and enter them into a web-based database. The participating students build a raw data source that can be used to test hypotheses in science classes but can also be accessed by other classrooms not involved in the sampling process and used as starting materials for mathematical and statistical investigations. Because the data are raw, many age levels depending on the questions and problems that the learners are interested in answering can use them.

The Book Report systems

This project design was based on previous models deployed at the Rice School/ La Escuela Rice, in Houston. Through a series of web based forms students post book reviews to the web. Using an on line database the materials are sorted according to level of complexity, language and genre. The on line reports are reviewed by teachers but are also used in other content areas such as theater arts to make decision on themes that are of interest to the student population.

Development site

The current development of the Electronic Studio is taking place at Hogg Middle School, in Houston, Texas. This is an inner city school, housed in a building that dates from 1926, serves approximately 1,300 students and has about 80 teachers.

This development of the Electronic Studio is the result of a grant awarded to the school by the Texas Telecommunications Infrastructure Fund. (http://www.tifb.state.tx.us/tif.html). The school, with the participation of teachers, administrators and university advisors, established as its goal to deploy a technological infrastructure to facilitate the integration of curriculum and technology.

Creating the technology environment

Preparing the learners

In the past, this school has in the past used computers in a more traditional ways and had no network access. To implement the Electronic Studio at this site is became necessary to train teachers as well as students.

The training model used with the teachers has been successfully implemented before at other k-12 institutions (Solís, 1977b). During the summer of 1997 sixteen teachers from all content areas and grade levels were trained intensively on the use of network technologies in the classroom. They were instructed in curriculum development in a technology rich environment and participated in classroom discussion that focused on teaching practices. After the summer training, monthly workshops were conducted to allow participants to refresh and update their skills. These teachers are now training other teachers in their teams. Students, on the other hand, learn in this environment through modeling, exploration, construction and by teaching each other. Furthermore, a resident consultant remains with the school and actively participates in the implementation of projects and in the school life in general.

Network Infrastructure

Hogg Middle School deployed, as part of this project, cabling for a network capable of serving 550 clients with the help of volunteers and at risk students under the advice of CTTL.

The school is connected to the district WAN and the Internet by a T1 line. All network transactions are handled through TCP/IP protocols. The network system is supported by a Windows NT® that functions as a resource server, a web server, a file storage system, and as a print server. To handle its web services, the system is equipped with Microsoft's Internet Information Server® (version 2.0 with Microsoft Active Server Pages® installed).

Classrooms

There is at least one networked computer in each classroom. Several classrooms have been set throughout the school with four to twenty networked systems. At the completion of this project each classroom will have at least eight networked computers. Due to a staggered influx of systems into the school and changing policies within the Houston Independent School District, Hogg Middle Schools classrooms are populated with a mixture of Apple Power Macintosh® and Windows 95® systems.

Essential to the implementation of the current Electronic Studio model is the uniformity of system configurations. Additionally, applications are carefully chosen, selecting those tools that show a high level of integration with each other. This is what enables learners to share in the production of information objects, regardless of where they find themselves in the schools. Therefore, all systems will be equipped with the same components: Ethernet cards,

Microsoft Internet Explorer ® World Wide Web browsers, mail clients and the Microsoft Office® application suite.

Technologies

The employed technologies and provided services are chosen to facilitate the achievement of the desired goals of curriculum integration with technology in a seamless environment. Because of the mix of operating systems and computer models the computing capabilities of the stations are not the same. The web server plays an important role in the integration and collaboration capabilities of the different elements of the Electronic Studio. The platform independence afforded by browser and server based applications overcomes these problems. For the applications developed for the school, many tasks are carried out by server scripts written as active server pages, where the server generates HTML based on user input and the content of server based databases http://www.microsoft.com/syspro/technet/boes/bo/iiserver/prodfact/aspover.htm).

One of the functions of the Electronic Studio is to serve as an area where completed projects can be displayed for others to learn from them. To facilitate this function in a heterogeneous computing environment Adobe Acrobat® (http://www.adobe.com/acrobat) networked printing services were installed in the system. This allows the participants to publish their work in a portable format that will retain all the characteristics of their creations.

Web databases

Web based databases are an integral part of the system since they enable the users to create a dynamic learning environment and to become active participants in the resource creation for the school. Having the learners access and interact with the databases through the browsers helps create a unified front for information, while bypassing the differences in platform and machine capabilities that characterize school environments.

Multimedia Galleries of images, movies and sounds

To support learners in the construction process, a number of resource galleries were put on line. Media galleries such as graphics, sounds and movies were placed on line and accessed through web pages. Previous work with similar groups demonstrated that the adoption of new teaching styles and the inclusion of technology in the curriculum was significantly affected by the number of on-line support structures provided to the learners (Solís, 1997b). This provides learners with a starter system for project development. Later on, individuals create their own galleries, which they share with others through their own web space.

Web Boarding

An important component of building a collaborative environment for construction is to enable users to communicate within and between teams. In this system two technologies were deployed. Basic communications are handled by e-mail, with web based e-mail directories for every member of the learning community. However, learners are also capable of exchanging ideas and documents through the use of a web boarding system that enables individuals to chat in real time, upload work in progress and post messages and follow ups (http://webboard.ora.com/). Threaded discussion groups were also set up to allow learners to exchange opinions on current events, and to respond to posted problems, allowing them to criticize each others solutions. This last approach is similar to the Guided Collaboration systems described by Guzdial et al. (1997).

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